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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	
APPEAL BRIEF	Atty. Docket No. **SYMM1110-1**

Applicant **Kishan Shenoi**	
Application Number **09/553,735**	Date Filed **04/20/00**
Title **CDMA Pilot Tracking for Synchronization**	
Group Art Unit **2631**	Examiner **Bayard, Emmanuel**
Confirmation Number: **5543**	

Certificate of Express Mailing Under 37 C.F.R. 1.10

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John J. Bruckner

Mail Stop Appeal Brief-Patents
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Dear Sir:

APPLICANTS' BRIEF ON APPEAL

This appeal brief is filed in accordance with 37 C.F.R. § 1.192 in the matter of the Appeal of the rejection of the claims of the above-referenced patent application. This appeal brief is being filed in triplicate. The Director of the U.S. Patent and Trademark Office is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-3204 of John Bruckner PC.

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(1) Real party in interest.

The real party in interest is Symmetricom Inc., 2300 Orchard Parkway, San Jose, California 95131-1017.

(2) Related appeals and interferences.

There are no other appeals or interferences known to appellant, the appellant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of claims.

Claims 1-7, 9-10, 12, 14-16, 18, 20-21, 23-31, 33-40 and 42-62 are pending in this application. Claims 8, 11, 13, 17, 19, 22, 32 and 41 were canceled without prejudice or disclaimer. Claims 1-7, 9-10, 12, 14-16, 18, 20-21, 23-31, 33-40 and 42-62 are appealed.

(4) Status of amendments.

This application is under final rejection. There is no amendment filed subsequent to final rejection.

(5) Summary of invention.

The claimed invention relates to methods and apparatus to track a pilot signal to discipline an oscillator using an estimate of the frequency error of the oscillator, wherein correlation values between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$ are averaged over multiple periods of the PN signals to improve a quality of pilot position estimation.

(6) Issues.

Has the Examiner committed error by failing to prove that claims 1-7, 9-10, 12, 14-16, 18, 20-21, 23-31, 33-40 and 42-62 are unpatentable under 35 U.S.C. § 103(a) as being obvious over U.S. 5,999,561 (Naden et al.) in view of U.S. 5,914,943 (Higuchi et al.)?

(7) Argument.

35 USC 103 Non-obviousness

Claims 1-7, 9-10, 12, 14-16, 18, 20-21, 23-31, 33-40 and 42-62 are rejected under 35 U.S.C. § 103(a) as obvious over U.S. 5,999,561 (Naden et al.) in view of U.S. 5,914,943 (Higuchi et al.).

The examiner has disregarded the two 37 CFR 1.132 Declarations previously received and entered into the record of this application on May 31, 2005 and October 15, 2004. In fact, the examiner has not once even acknowledged (much less addressed) the two 37 CFR 1.132 Declarations. Both of the Declarations enter evidence into the record regarding the primary U.S. 5,999,561 (Naden et al.) reference. Both of the Declarations enter evidence into the regarding the claimed invention. Therefore, the 37 CFR 1.132 Declarations filed May 31, 2005 and October 15, 2004 provide evidence of the examiner's error with regard to this obviousness rejection. Copies of the 37 CFR 1.132 Declarations filed May 31, 2005 and October 15, 2004 are filed herewith in triplicate. The BOPAI is requested to weight the evidence presented by the 37 CFR 1.132 Declarations.

With regard to this obviousness ground of rejection, claims (1-7, 9-10, 12, 14-16, 18, 20-21, 23) and (24-31, 33-40 and 42-62) do NOT stand or fall together because claims (1-7, 9-10, 12, 14-16, 18, 20-21, 23) are directed to downconverting an RF signal from a RF center frequency f_{RF} to an intermediate center frequency f_L where f_L is greater than or equal to a chip rate f_c, wherein downconverting includes incorporating bandpass filtering to remove extraneous signals while

passing said pilot channel signal; converting a signal format from analog to digital using a single analog-to-digital converter employing a sampling rate of f_s to create a digital signal $\{s(n)\}$; employing a correlation circuit to establish a correlation between {s(n)} and locally generated versions of I-channel and Q-channel PN signals, $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, respectively; generating an estimate of a frequency error of the oscillator using correlation values corresponding to (2M+1) time shifts of $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, the (2M+1) time shifts being $K-\Delta_M$, $K-\Delta_{(M-1)}$, . . . , $K-\Delta_2$, $K-\Delta_1$, K, and $K+\Delta_1$, $K+\Delta_2$, . . . , $K+\Delta_{(M-1)}$, $K+\Delta_M$, where a time shift of K corresponds to a time shift that provides a maximum correlation value, and M is greater than or equal to 1; and disciplining the oscillator using the estimate of the frequency error of the oscillator, wherein correlation values between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$ are averaged over multiple periods of the PN signals, while claims (24-31, 33-40 and 42-62) are directed to generating a spectrum shaped channel pilot signal $\{\gamma(n)\}$ from a chip-rate PN sequence $\{i(n)\}$ by: oversampling the chip-rate PN sequence $\{i(n)\}$ at a higher sampling rate to yield a signal $\{a(n)\}$; passing $\{a(n)\}$ through a first FIR filter whose impulse response coefficients are $\{g(n)\}$ to yield a signal $\{\vartheta(n)\}$; and filtering $\{\vartheta(n)\}$ with a second FIR filter to yield the spectrum shaped channel pilot signal $\{\gamma(n)\}$; and averaging correlation values between the signal $\{a(n)\}$ and the spectrum shaped channel pilot signal $\{\gamma(n)\}$ over multiple periods of the chip-rate PN sequence.

The claimed invention requires <u>correlation values between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$ averaged over multiple periods of the PN signals</u>. All of independent claims 1, 14, 23, 24 and 34 were previously amended to require that the present invention's correlation values that are averaged over multiple periods of the PN signals (e.g., long code) are between the signal and the long code itself. This important limitation is explicitly recited in independent claims 1, 14 and 23 as "over multiple periods of the PN signals." This important limitation is similarly explicitly

recited in independent claims 24 and 34 as "over multiple periods of the chip-rate PN sequence."

Naden (U.S. 5,999,561) teaches a methodology for DSSS (Direct Sequence Spread Spectrum) terminals. Naden teaches a DSSS receiver that is of the tracking variety. That is, a continuous monitoring and estimation of correlation must be made by Naden *on the channel being used for communication*. The Naden correlation must be made for "early", "late", and "on-time". Naden actually uses four "early" and four "late" estimates corresponding to time-offsets of (1/4), (1/2), (3/4), and (1) chips. Furthermore, the tracking aspect of the Naden receiver mandates that these four estimates be done for *each period* of the spreading code and Naden must dwell on his single spreading code 100% of the time. The Naden reference does not disclose or suggest averaging over multiple code periods.

Naden's teachings relate to a *DSSS radio with the emphasis on communications* and the attendant need for low power, long battery life, power management, and such attributes. In sharp contrast, the claimed invention is closer to the notion of a *measurement instrument* that monitors radio transmission and extracts the information necessary to discipline a high quality oscillator such as a Rubidium Atomic Standard or high performance oven controlled crystal oscillator ("OCXO").

Higuchi (U.S. 5,914,943) teaches establishing acquisition of spreading code in CDMA transmission systems. At the bottom of page 3, the Examiner states that "Higuchi teaches correlation values are averaged over plurality of intervals of long codes is the same as the claimed (wherein correlation values between the digital signal and at least one locally generated version of I-channel and Q-channel PN signals are averaged over multiple periods of the PN signals (long codes) to improve a quality of pilot position estimation." The Examiner cites Higuchi figures 7 and 13-15; column 4, lines 50-65; column 5, lines 28-30 and 65-67; column 6, lines 25-28; column 9, lines 20-30; column 13, lines 5-10 and column 14, lines 20-50. However, the

Examiner is mistaken because Higuchi does not disclose or suggest averaging correlation values between the signal and the long code itself over multiple periods of the long code. All the pending independent claims of this application specify what is being correlated as well as over what period they are being correlated. Both limitations are part of the claimed invention.

Higuchi figures 7 and 13-15 do not disclose or suggest averaging correlation values between the long code and the digital signal over multiple periods of the long code. Higuchi, column 4, lines 50-65 describes comparing an output of the I-correlator with an output of the Q-correlator, but does not disclose or suggest correlating either of these with the digital signal itself. Higuchi, column 5, lines 28-30 and 65-67 does not disclose or suggest averaging correlation values between the long code and the digital signal over multiple periods of the long code. Higuchi, column 6, lines 25-28 does not disclose or suggest averaging correlation values between the long code and the digital signal over multiple periods of the long code. Higuchi, column 9, lines 20-30 does not disclose or suggest averaging correlation values between the long code and the digital signal itself over multiple periods of the long code. Higuchi, column 13, lines 5-10 does not disclose or suggest averaging correlation values between the long code and the digital signal. Higuchi column 14, lines 20-50 describes averaging i) a correlation between an output of the I-correlator and the signal with ii) a correlation between an output of the Q-correlator and the signal, but does not disclose or suggest averaging correlation values between the long code with the digital signal over multiple periods of the long code. **Higuchi simply does not disclose or suggest averaging correlations between a signal and the long code itself over multiple periods of the long code.**

With regard to claims 44-47, these embodiments of the claimed invention require averaging C_{MS} over multiple correlation computations in order to reduce the impact of any extraneous signal." This embodiment of the invention can provide the significant advantage of reducing the impact of an extraneous signal. Thus, dependent claims 44-47 are each

considered to be separately patentable.

With regard to claims 48-49 and 51-52, these embodiments of the claimed invention require synthesizing an offset to improve precision of an estimate of time-of-arrival of a received pilot code based on a ratio of i) a sum of correlation values prior to on-time to ii) a sum of correlation values after on-time. These embodiments of the invention can correlate lags smaller than the sampling interval by interpolation. These embodiments of the invention can provide a finer grain of lags than the $4f_c$ (where f_c is the chip rate) sampling interval of Naden. Referring to the first full paragraph of page 27 of this application as originally filed, a specific algorithm for implementing this embodiment of the invention is described. Thus, dependent claims 48-49 and 51-52 are each considered to be separately patentable.

With regard to claims 20, 43 and 53-58, these embodiments of the claimed invention require tracking multiple pilots. Referring to the first sentence of the last full paragraph of page 20 of this application as originally filed, it is stated that "[b]y using multiple correlators in parallel, or by 'time-sharing' correlators, multiple pilots can be tracked. This embodiment of the invention provides significant advantages when multiple pilots are available. Naden's architecture can work only with a single channel, corresponding to a channel being used for communication. Therefore, Naden teaches away from these embodiments of the claimed invention. The 'time-sharing' embodiments of claims 55-58 do not "dwell" on a pilot channel 100% of the time but can observe it for a while and then come back to it later by remembering the (approximate) location of time-of-arrival relative to the local counter. This is facilitated by the doing several correlation lags just in case the "on-time" location has moved, which it could if the local time-base is offset somewhat from the transmitter time-base. Thus, dependent claims 20, 43 and 53-58 are each considered to be separately patentable.

With regard to claims 59-62, these embodiments of the claimed invention require the use of *different PN codes for the I and Q channels*, requiring the receiver to do likewise. In sharp

contrast, Naden teaches a receiver that can only be used with a single PN code. Naden teaches a conventional DSSS radio architecture whereby the phase difference between the local oscillator and the remote transmitter is rendered moot by applying the dispreading code to both I and Q channels. This is emphasized by Fig. 11 of Naden which shows a single PN code generator (1120) that is applied to both the I and Q channels. Thus, dependent claims 59-62 are each considered to be separately patentable.

Accordingly, reversal of this rejection is respectfully requested.

Other than as explicitly set forth above, this appeal brief does not include acquiescence to statements in the Office Actions. In view of the above, all the pending claims are considered patentable and reversal of all grounds is requested.

A check to pay the fee set forth in 37 CFR § 41.20(b)(2) for filing a brief in support of an appeal is enclosed.

In accordance with 37 CFR 1.136(a) pertaining to patent application processing fees, Applicant requests an extension of time from February 9, 2006 to June 9, 2006 in which to file this appeal brief. A notification of extension of time is filed herewith.

The Director of the U.S. Patent and Trademark Office is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-3204 of John Bruckner PC.

Respectfully submitted,

John Bruckner PC
Attorney(s) for Applicant(s)

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Dated: Jun 9, '06

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(8) Claims Appendix.

The following is a copy of the claims involved in the appeal.

1. A method for tracking a pilot channel signal to discipline an oscillator, comprising:

downconverting an RF signal from a RF center frequency f_{RF} to an intermediate center frequency f_L where f_L is greater than or equal to a chip rate f_c, wherein downconverting includes incorporating bandpass filtering to remove extraneous signals while passing said pilot channel signal;

converting a signal format from analog to digital using a single analog-to-digital converter employing a sampling rate of f_s to create a digital signal $\{s(n)\}$;

employing a correlation circuit to establish a correlation between {s(n)} and locally generated versions of I-channel and Q-channel PN signals, $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, respectively;

generating an estimate of a frequency error of the oscillator using correlation values corresponding to (2M+1) time shifts of $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, the (2M+1) time shifts being $K-\Delta_M$, $K-\Delta_{(M-1)}$, . . . , $K-\Delta_2$, $K-\Delta_1$, K, and $K+\Delta_1$, $K+\Delta_2$, . . . , $K+\Delta_{(M-1)}$, $K+\Delta_M$, where a time shift of K corresponds to a time shift that provides a maximum correlation value, and M is greater than or equal to 1; and

disciplining the oscillator using the estimate of the frequency error of the oscillator,

wherein correlation values between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$ are averaged over multiple periods of the PN signals to improve a quality of pilot position estimation.

2. The method of claim 1, wherein the sampling rate, f_s, the intermediate center frequency, f_L, and the chip rate f_c, are related by $f_s=4f_c$, and $f_L=f_c+kf_s$ for k=0.

3. The method of claim 1, wherein the sampling rate, f_s, the intermediate center frequency, f_L, and the chip rate f_c, are related by $f_s=4f_c$, and $f_L=f_c+kf_s$ for k=1.

4. The method of claim 1, wherein the sampling rate, f_s, the intermediate center frequency, f_L, and the chip rate f_c, are related by $f_s=4f_c$, and $f_L=f_c+kf_s$ for k=2.

5. The method of claim 1, wherein the correlation circuit uses a single accumulator for generating both an in-phase ("real") part and a quadrature ("imaginary") part of a complex correlation between the digital signal $\{s(n)\}$ and a given time shifted version of the locally generated versions of $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$.

6. The method of claim 5, wherein both positive overflows and negative underflows are monitored.

7. The method of claim 1, wherein a matched filter is not employed.

9. The method of claim 1, wherein correlations are computed at time shift lags which are commensurate with the sampling rate.

10. The method of claim 9, wherein correlations for lags smaller than the sampling interval are synthesized using digital signal processing.

12. The method of claim 1, further comprising computing correlations over a period less than the time period of the PN signals using an autonomous background correlator.

14. An apparatus to track a pilot signal to discipline an oscillator, comprising:

a correlator circuit adapted to compute a complex correlation between a received version of the pilot signal and locally generated versions of I-channel and Q-channel PN signals, $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, respectively; and

a signal processor circuit coupled to the correlator circuit,

wherein the signal processor circuit disciplines the oscillator and averages correlation values between the received version of the pilot signal and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$ over multiple periods of the PN signals to improve a quality of pilot position estimation.

15. The apparatus of claim 14, wherein said correlator circuit includes an FPGA.

16. The apparatus of claim 14, wherein the correlator circuit includes a single accumulator that computes both the real and imaginary part of the complex correlation.

18. The apparatus of claim 14, wherein said signal processor circuit includes a DSP.

20. A receiver including two of the apparatus according to claim 14 that are operated in parallel to track multiple pilots.

21. The receiver of claim 20, wherein at least one correlator computes correlation values over a time period of less than one period of the PN signals and is used as an autonomous background correlator.

23. A method for tracking a pilot channel to discipline an oscillator, comprising:

downconverting the RF signal from the RF center frequency, f_{RF} to an intermediate center frequency of f_L, where f_L is greater than or equal to the chip rate, f_c, said downconversion incorporating bandpass filtering to remove extraneous signals while passing said pilot channel signal;

converting signal format from analog to digital using a single analog-to-digital converter employing a sampling rate of f_s, to create the digital signal $\{s(n)\}$;

employing correlation to establish the correlation between {s(n)} and locally generated versions of I-channel and Q-channel PN signals, $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, respectively;

generating an estimate of the frequency error of the oscillator using correlation values corresponding to (2M+1) time shifts of the locally generated versions of $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$, said time shifts being $K-\Delta_M$, $K-\Delta_{(M-1)}$,. . . , $K-\Delta_2$, $K-\Delta_1$, K, and $K+\Delta_1$, $K+\Delta_2$, . . . , $K+\Delta_{(M-1)}$, $K+\Delta_M$, where time shift of K corresponds to the time shift that provides a maximum correlation

value, and the value of M is 4; and

disciplining the oscillator using the estimate of the frequency error of the oscillator,

wherein correlation values between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$ are averaged over multiple periods of the PN signals to improve a quality of pilot position estimation.

24. A method of tracking a pilot channel to discipline an oscillator, comprising:

disciplining an oscillator including generating a spectrum shaped channel pilot signal $\{\gamma(n)\}$ from a chip-rate PN sequence $\{i(n)\}$ by:

oversampling the chip-rate PN sequence $\{i(n)\}$ at a higher sampling rate to yield a signal $\{a(n)\}$;

passing $\{a(n)\}$ through a first FIR filter whose impulse response coefficients are $\{g(n)\}$ to yield a signal $\{\vartheta(n)\}$; and

filtering $\{\vartheta(n)\}$ with a second FIR filter to yield the spectrum shaped channel pilot signal $\{\gamma(n)\}$; and

averaging correlation values between the signal $\{a(n)\}$ and the spectrum shaped channel pilot signal $\{\gamma(n)\}$ over multiple periods of the chip-rate PN sequence to improve a quality of pilot position estimation.

25. The method of claim 24, wherein the spectrum shaped channel pilot signal $\{\gamma(n)\}$ is a spectrum shaped I-channel pilot signal.

26. The method of claim 24, wherein both positive overflows and negative overflows are monitored.

27. The method of claim 24, further comprising translating the spectrum shaped I channel pilot signal $\{y(n)\}$ down to a zero-offset-carrier frequency signal $\{s(n)\}$.

28. The method of claim 27, further comprising translating the zero-offset-carrier frequency signal $\{s(n)\}$ down to a baseband signal $\{w(n)\}$.

29. The method of claim 24, wherein a sampling clock is derived from a VCXO that is phase-locked to a reference frequency.

30. The method of claim 24, wherein a correlation is computed at lags which are commensurate with a sampling rate.

31. The method of claim 24, wherein a matched filter is not employed.

33. The method of claim 24, wherein the spectrum shaped channel pilot signal $\{y(n)\}$ is a spectrum shaped Q-channel pilot signal.

34. An apparatus to track a pilot signal to discipline an oscillator, comprising:

a correlator circuit adapted to oversample a chip-rate PN sequence $\{i(n)\}$ at a higher sampling rate to yield a signal $\{a(n)\}$, pass $\{a(n)\}$ through a first FIR filter whose impulse response coefficients are $\{g(n)\}$ to yield a signal $\{\vartheta(n)\}$; and filter $\{\vartheta(n)\}$ with a second FIR filter to yield a spectrum shaped pilot channel signal $\{\gamma(n)\}$; and

a signal processor circuit coupled to the correlator circuit,

wherein the signal processor circuit disciplines the oscillator and averages correlation values between the signal $\{a(n)\}$ and the spectrum shaped channel pilot signal $\{\gamma(n)\}$ over multiple periods of the chip-rate PN sequence to improve a quality of pilot position estimation.

35. The apparatus of claim 34, wherein said correlator circuit includes a FPGA.

37. The apparatus of claim 34, wherein said signal processor circuit includes a DSP.

38. The apparatus of claim 34, further comprising an A/D converter coupled to said signal processor circuit.

39. The apparatus of claim 34, wherein the first FIR filter includes a 4-point FIR filter having all 4 coefficients at least substantially equal.

40. The apparatus of claim 34, wherein the second FIR filter includes a 48-point FIR filter.

42. The apparatus of claim 34, further comprising an autonomous background correlator

coupled to the correlator circuit.

43. A receiver comprising at least two of the apparatus according to claim 34 that are operated in parallel to track multiple pilots.

44. The method of claim 1, wherein averaging includes averaging C_{MS} over multiple correlation computations to reduce noise

45. The apparatus of claim 14, wherein the signal processor averages C_{MS} over multiple correlation computations to reduce noise.

46. The method of claim 24, wherein averaging includes averaging C_{MS} over multiple correlation computations to reduce noise.

47. The apparatus of claim 34, wherein the signal processor averages C_{MS} over multiple correlation computations to reduce noise.

48. The method of claim 10, wherein using digital signal processing includes synthesizing an offset to improve precision of an estimate of time-of-arrival of a received pilot code.

49. The apparatus of claim 18, wherein the DSP synthesizes an offset to improve precision of an estimate of time-of-arrival of a received pilot code.

50. The method of claim 24, wherein correlations for lags smaller than the sampling interval are synthesized using digital signal processing.

51. The method of claim 50, wherein using digital signal processing includes synthesizing an offset to improve precision of an estimate of time-of-arrival of a received pilot code.

52. The apparatus of claim 34, wherein the DSP synthesizes an offset to improve precision of an estimate of time-of-arrival of a received pilot code.

53. The method of claim 1, further comprising employing another correlator circuit in parallel to track multiple pilots.

54. The method of claim 24, further comprising disciplining another oscillator in parallel to track multiple pilots including generating another spectrum shaped channel pilot signal by:

oversampling to yield another signal;

passing the another signal through another FIR filter; and

filtering with another second FIR filter to yield the another spectrum shaped channel pilot signal.

55. The method of claim 1, wherein the correlation circuit is time shared to track multiple pilots.

56. The apparatus of claim 14, wherein the correlator circuit is time shared to track multiple pilots.

57. The method of claim 24, further comprising time sharing a correlator circuit to track multiple pilots.

58. The apparatus of claim 34, wherein the correlator circuit is time shared to track multiple pilots.

59. The method of claim 1, wherein the I-channel and Q-channel PN signals are different.

60. The apparatus of claim 14, wherein the I-channel and Q-channel PN signals are different.

61. The method of claim 24, wherein disciplining an oscillator includes generating another spectrum shaped channel pilot signal from another different chip-rate PN sequence.

62. The apparatus of claim 34, wherein the correlator circuit adapted to oversample another different chip-rate PN sequence.

(9) Evidence Appendix.

List of admitted evidence (full copies attached)

Affidavit (Rule 132) by inventor Kishan Shenoi

received and admitted May 31, 2005

Affidavit (Rule 132) inventor Kishan Shenoi

received and admitted October 15, 2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	
DECLARATION UNDER 37 CFR 1.132	Atty. Docket No. **SYMM1110-1**

Applicant **Kishan Shenoi**	
Application Number **09/553,735**	Date Filed **April 20, 2000**
Title **CDMA Pilot Tracking for Synchronization**	
Group Art Unit **2631**	Examiner **Bayard, Emmanuel**
Confirmation Number: **5543**	

Certificate of Express Mailing Under 37 C.F.R. 1.10

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John J. Bruckner

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Kishan Shenoi, declare as follows:

I am the inventor of the above-identified pending U.S. utility patent application.

In order to recognize the distinctions between the claimed invention and the prior art that the Examiner has cited (e.g. Naden 5,999,561; Higuchi 6,167,037; Schoolcraft 5,237,587) it is important to recognize the context in which the invention is applied.

Higuchi (and Naden and Schoolcraft) are concerned with a *DS-CDMA receiver used for communication and thus are primarily concerned with data (information) extraction*. The above-identified application describes methodology better suited for *measurement of the time-of-arrival of the (starting point of the) spreading code relative to a local clock*.

In conventional receivers, primarily from cost-of-goods criteria, the oscillator used will be, typically, a quartz resonator. In the application area of the claimed invention, the oscillator quality will be much higher, typically a rubidium secondary atomic standard. The implications of

this statement will become apparent shortly.

Synchronization for both Higuchi and Naden, in terms of establishing the start of the spreading code is vital for data extraction and must be done in the case of Higuchi and Naden both rapidly and with enough accuracy to reliably extract the data (information). This implies that the receiver must be agile enough to follow multi-path. Furthermore, it is advantageous for Naden (and Higuchi) to determine the strongest multipath component. Schemes, referred to as "rake receivers" in the literature can be implemented to use multiple multipath components to improve the quality of data extraction (e.g. Schoolcraft). In contradistinction to both Higuchi and Naden, the claimed invention is directed to a measurement methodology that is concerned with making a very precise and accurate estimate of the start of the spreading code that is completely independent of a need to extract data; the claimed invention (this estimation) can be done over intervals of time much longer than the symbol interval. Furthermore, of specific interest is the "earliest arrival" which corresponds, in all likelihood, to the most direct path between the transmitter and receiver. It should be noted that the "earliest arrival" may not be the one with the most signal strength.

Higuchi teaches the determination of the dominant correlation peak by "searching" around the expected arrival time. The intent is to maximize signal-to-noise ratio for data extraction. In contradistinction, the claimed invention determines the correlation values for time-offsets around the expected arrival time to establish whether the "earliest arrival" (typically, but not always, the dominant correlation peak) has moved with respect to the local clock; the intent is to see whether the time-base of the transmitter is different from the time-base of the receiver. In rake receiver methodology the multiple correlation peaks are "intelligently combined" (e.g. Schoolcraft) to improve the effective signal-to-noise ratio in order to get more robust data extraction. In contradistinction, the claimed invention utilizes the multiple correlation peaks to estimate a more precise time-of-arrival of the "earliest arrival".

Since Higuchi (and Naden and Schoolcraft) are interested in continuous data extraction, they must track the time-of-arrival of the dominant (and other multi-path signals if rake techniques are employed) signal *continuously*. Consequently the disciplining of the local oscillator must be of the phase-locked-loop variety. This, in conjunction with the notion of an

inexpensive oscillator, implies that averaging, if any, can be done only over a limited period of time. In contradistinction, the claimed invention, since it is only looking for a measurement often enough to discipline the high quality (typically rubidium secondary atomic standard) oscillator, can afford to have "gaps" in its observation pattern. That is, it can observe a pilot signal for a period of time while it is doing the averaging, develop an estimate of time-of-arrival with respect to its local clock, and then "ignore" the pilot signal for a period of time. The stability of the local oscillator allows this to work, because the "expected time of arrival" will not have shifted by much. The disciplining of the rubidium oscillator is based on frequency-locked loop methods (because of the possibility of "gaps" in the measurement process).

All of independent claims 1, 14, 23, 24 and 34 were amended to require that the present invention's correlation values that are averaged over multiple periods of the PN signals (e.g., long code) are between the signal and the long code itself. This important limitation is explicitly recited in independent claims 1, 14 and 23 as "over multiple periods of the PN signals." This important limitation is similarly explicitly recited in independent claims 24 and 34 as "over multiple periods of the chip-rate PN sequence." **Higuchi simply does not disclose or suggest averaging correlations <u>between a signal and the long code itself</u>.** This will be explained in more detail in the following paragraphs.

IS-95 CDMA, as practiced in North America and elsewhere is indeed a form of DS-CDMA where multiple spreading codes are employed (see Higuchi col. 1, lines 26-35). In particular, a 64-length Gold code is the "short code" with period equal to that of an information symbol (bit). This "short code" can be used to separate channels of information (each user would use one channel). PN codes length $2^{15} = 32768$ are superimposed (there are two, specifically, a first for the I channel and a second for the Q channel) and these, together are referred to as the "long code" by Higuchi, can be used to distinguish base stations. In IS-95 CDMA, all base stations use the same long code but each base station uses a different time offset (thus base stations are distinguished by their time offset).

Higuchi (and Naden) are concerned with a DS-CDMA receiver, and thus are primarily concerned with data (information) extraction. Synchronization for both Higuchi and Naden, in terms of establishing the start of the spreading code is vital for data extraction and must be done

in the case of Higuchi and Naden both rapidly and with enough accuracy to reliably extract the data (information). In contradistinction to both Higuchi and Naden, the claimed invention is directed to a measurement methodology that is concerned with making a very precise and accurate estimate of the start of the spreading code that is completely independent of a need to extract data; the claimed invention (this estimation) can be done over intervals of time much longer than the symbol interval.

Higuchi is concerned with acquisition and more importantly the need to acquire code synchronization in a rapid manner (see Higuchi col. 3, lines 33-65). To this end, Higuchi proposes masking the second code group for M (≥1) symbols at fixed intervals (see col. 4 lines 12-17 and Claim 1). As is clear from Higuchi Fig. 15 and Fig. 7, the correlation is performed between the input signal *and the short code*. Clearly this correlation can be done only in the window of M symbols while the long code is masked. Higuchi recites the need for introducing this window where the long code is masked at the same point in each long code period and thus the statement in Higuchi at col. 14, lines 3-5 "... as shown in Fig. 15 (correlation values are also available which are obtained by averaging over a plurality of long code periods),..." necessarily implies that the averaging of Higuchi, if done at all, is done of the correlation values obtained over M symbols (the masking interval) in consecutive long code periods. Considering that this is being done by Higuchi in the acquisition phase and so the local time-base has not yet been synchronized to the transmitter time-base, it is unlikely that averaging over many periods will beneficial; in fact averaging over many long code intervals is contraindicated by Higuchi.

Thus, it is thus very clear that while Higuchi teaches that averaging during a plurality of long code time periods may be employed, **every one of Higuchi's averaged correlations is between the short code and the input signal because they are constructed during intervals when the long code is masked and unavailable to Higuchi. Therefore, Higuchi teaches away from the presently claimed invention that includes averaging a correlation between a signal and the long code itself.**

In IS-95 CDMA, an arena to which embodiments of the invention may be directed, there is no masking interval for the "long code" (i.e., both the I PN sequence and the Q PN sequence are continuous with no gaps). This Application teaches embodiments including the generation of

correlations using a pilot channel. The Gold code for the pilot channel is typically the null code (all 1s) which has no useful correlation properties with the input signal, especially considering that the long code is not masked in IS-95 CDMA. Therefore averaging over a plurality of long code periods of the correlation between the short code and the input signal as might be suggested by Higuchi has no bearing on the IS-95 CDMA embodiments of this invention.

What Higuchi does not describe or teach is the notion of averaging, over a plurality of long code periods, the correlation between the *long code* and the input signal. In fact, when correlation between the long code and the input signal is calculated by Higuchi, it is evident from Fig. 16 (and Fig. 17, and Fig. 18) that Higuchi reverts back to the conventional tracking receiver such as taught by Naden.

Naden teaches a methodology for DSSS (Direct Sequence Spread Spectrum) terminals. Naden teaches a DSSS receiver that is of the tracking variety. That is, a continuous monitoring and estimation of correlation must be made by Naden *on the channel being used for communication*. The Naden correlation must be made for "early", "late", and "on-time". Naden actually uses four "early" and four "late" estimates corresponding to time-offsets of (1/4), (1/2), (3/4), and (1) chips. Furthermore, the tracking aspect of the Naden receiver mandates that these four estimates be done for *each period* of the spreading code and Naden must dwell on his single spreading code 100% of the time. The Naden reference does not disclose or suggest averaging over multiple code periods.

In general, Naden's teachings relate to a *DSSS radio with the emphasis on communications* and the attendant need for low power, long battery life, power management, and such attributes. In sharp contrast, the claimed invention is closer to the notion of a *measurement instrument* that monitors radio transmission and extracts the information necessary to discipline a high quality oscillator such as a Rubidium Atomic Standard or high performance oven controlled crystal oscillator ("OCXO").

With regard to claims 44-47, these embodiments of the claimed invention require averaging C_{MS} over multiple correlation computations in order to reduce the impact of any extraneous signal." This embodiment of the invention can provide the significant advantage of reducing the impact of an extraneous signal.

With regard to claims 48-49 and 51-52, these embodiments of the claimed invention require synthesizing an offset to improve precision of an estimate of time-of-arrival of a received pilot code based on a ratio of i) a sum of correlation values prior to on-time to ii) a sum of correlation values after on-time. These embodiments of the invention can correlate lags smaller than the sampling interval by interpolation. These embodiments of the invention can provide a finer grain of lags than the $4f_c$ (where f_c is the chip rate) sampling interval of Naden. Referring to the first full paragraph of page 27 of this application as originally filed, a specific algorithm for implementing this embodiment of the invention is described.

With regard to claims 20, 43 and 53-58, these embodiments of the claimed invention require tracking multiple pilots. Referring to the first sentence of the last full paragraph of page 20 of this application as originally filed, it is stated that "[b]y using multiple correlators in parallel, or by 'time-sharing' correlators, multiple pilots can be tracked. This embodiment of the invention provides significant advantages when multiple pilots are available. Naden's architecture can work only with a single channel, corresponding to a channel being used for communication. Therefore, Naden teaches away from these embodiments of the claimed invention. The 'time-sharing' embodiments of claims 55-58 do not "dwell" on a pilot channel 100% of the time but can observe it for a while and then come back to it later by remembering the (approximate) location of time-of-arrival relative to the local counter. This is facilitated by the doing several correlation lags just in case the "on-time" location has moved, which it could if the local time-base is offset somewhat from the transmitter time-base.

With regard to claims 59-62, these embodiments of the claimed invention require the use of *different PN codes for the I and Q channels*, requiring the receiver to do likewise. In sharp contrast, Naden teaches a receiver that can only be used with a single PN code. Naden teaches a conventional DSSS radio architecture whereby the phase difference between the local oscillator and the remote transmitter is rendered moot by applying the dispreading code to both I and Q channels. This is emphasized by Fig. 11 of Naden which shows a single PN code generator (1120) that is applied to both the I and Q channels.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these

statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

05/31/2005
Dated:

Kishan Shenoi
Name: Kishan Shenoi

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	
DECLARATION UNDER 37 CFR 1.132	Atty. Docket No. **SYMM1110-1**

Applicant **Kishan Shenoi**	
Application Number **09/553,735**	Date Filed **04/20/00**
Title **CDMA Pilot Tracking for Synchronization**	
Group Art Unit **2631**	Examiner **Bayard, Emmanuel**
Confirmation Number: **5543**	

Certificate of Express Mailing Under 37 C.F.R. 1.10
I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office to Addressee in an envelope bearing Express Mail mailing label number ED 202405848 US addressed to: Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450 on Oct. 15, 2004.

John J. Bruckner

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Kishan Shenoi, declare as follows:

I am the inventor of the above-identified pending U.S. utility patent application.

All of independent claims 1, 14, 23, 24 and 34 are now amended to require that the present invention's correlation values that are averaged over multiple periods of the PN signals (e.g., long code) are between the signal and the long code itself. This important limitation is explicitly recited in independent claims 1, 14 and 23 as "over multiple periods of the PN signals." This important limitation is similarly explicitly recited in independent claims 24 and 34 as "over multiple periods of the chip-rate PN sequence." **Higuchi simply does not disclose or suggest averaging correlations between a signal and the long code itself.** This will be explained in more detail in the following paragraphs.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

OCT. 14, 2004
Dated:

Kishan Shenoi
Name: Kishan Shenoi

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

NOTIFICATION OF EXTENSION OF TIME UNDER 37 C.F.R § 1.136

Atty. Docket No. **SYMM1110-1**

Applicant **Kishan Shenoi**	
Application Number **09/553,735**	Date Filed **04/20/00**
Title **CDMA Pilot Tracking for Synchronization**	
Group Art Unit **2631**	Examiner **Bayard, Emmanuel**
Confirmation Number: **5543**	

Certificate of Express Mailing Under 37 C.F.R. 1.10

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office to Addressee in an envelope bearing Express Mail mailing label number **EQ 751363710 US** addressed to: Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450 on June 9, 2006.

John J. Bruckner

Mail Stop Appeal Brief-Patents
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicant hereby takes an Extension of Time for responding to the Office Action mailed December 28, 2004 for a period of four (4) month(s).

		Small Entity	*Large Entity*
	First Month	\$ 60.00	\$ 120.00
	Second Month	\$ 225.00	\$ 450.00
	Third Month	\$ 510.00	\$ 1020.00
X	Fourth Month	\$ 795.00	\$ 1,590.00
	Fifth Month	\$ 1,080.00	\$ 2,160.00
	TOTAL	**\$0.00**	**\$ 1590.00**

A check for the Extension of Time for a large entity is enclosed. The Director of the U.S. Patent and Trademark Office is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-3204 of John Bruckner PC.

Respectfully submitted,

Dated: Jun 9, '06

John Bruckner PC

Attorney(s) for Applicant(s)

5708 Back Bay Lane
Austin, TX 78739
Tel. (512) 394-0118
Fax. (512) 394-0119

John J. Bruckner
Reg. No. 35,816

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